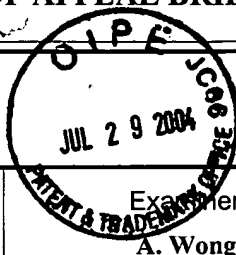


TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No.
EN998027

In Re Application Of: Boice, et al.



Application No.
09/046,118

Filing Date
03/20/1998

Examiner
A. Wong

Customer No.
23405

Group Art Unit
2613

Confirmation No.
1827

Invention: **ADAPTIVE ENCODING OF A SEQUENCE OF STILL FRAMES OR PARTIALLY STILL FRAMES WITHIN MOTION VIDEO**

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Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on June 21, 2004

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- ☐ A check in the amount of the fee is enclosed.
- ☐ The Director has already been authorized to charge fees in this application to a Deposit Account.
- ☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 09-0457 (IBM)

Kevin P. Radigan
Signature

Dated: July 27, 2004

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellants: Boice et al.

Serial No.: 09/046,118

Filed: 03/20/98



Group Art Unit: 2613

Examiner: Wong, A.

Appeal No.:

For: ADAPTIVE ENCODING OF A SEQUENCE OF STILL FRAMES OR
PARTIALLY STILL FRAMES WITHIN MOTION VIDEO

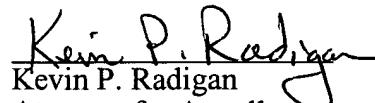
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Brief of Appellants

Dear Sir:

This is an appeal from a final rejection, dated May 6, 2004, rejecting claims 1, 2, 7, 8, 10-28 and 31-41 and objecting to claims 3-6, 9, 29 and 30, all the claims being considered in the above-identified application. This Brief is accompanied by a transmittal letter authorizing the charging of Appellants' deposit account for payment of the requisite fee set forth in 37 C.F.R. §1.17(c).

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Real Party In Interest

This application is assigned to **International Business Machines Corporation** by virtue of an assignment executed by the inventors on March 19, 1998, and recorded with the United States Patent and Trademark Office at reel 009053, frame 0192, on March 20, 1998. Therefore, the real party in interest is **International Business Machines Corporation**.

Related Appeals and Interferences

To the knowledge of the Appellants, Appellants' undersigned legal representative, and the assignee, there are no other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in the instant appeal.

Status of Claims

This patent application was filed on March 20, 1998, with the U.S. Patent and Trademark Office. As filed, the application included 41 claims, of which five (5) were independent claims (i.e., claims 1, 19, 23, 34 & 37).

In an initial Office Action dated June 5, 2000, claims 1, 19, 23, 34 and 37 were rejected under 35 U.S.C. §112, first paragraph, as based on a disclosure that was not enabling; claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger (U.S. Patent No. 5,426,463; hereinafter, "Reinger"); and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated August 31, 2000, the specification was amended.

In a second and final Office Action dated November 7, 2000, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated January 8, 2001, claims 1, 14, 19, 23, 31, 34, 37 & 41 were amended.

In an Advisory Action dated January 24, 2001, Appellants' response was considered, however Appellants' amendments were not entered on grounds that the amendments raised new issues requiring a new search. In response, Appellants filed a Continued Prosecution Application (CPA) on February 6, 2001, that requested consideration of the amendments submitted January 8, 2001.

In an Office Action dated April 16, 2001, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Yanagihara (U.S. Patent No. 5,321,440; hereinafter, "Yanagihara") and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated August 16, 2001, claims 1, 19, 23, 34 & 37 were amended.

In a final Office Action dated November 2, 2001, claims 1, 19, 23, 34 and 37 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point and distinctly claim the subject matter Appellant regarded as the invention; claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Yanagihara; and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated December 21, 2001, claims 1, 19, 23, 34 & 37 were amended.

In an Advisory Action dated January 10, 2002, Appellants' response was considered, however Appellants' amendments were not entered on grounds that the amendments raised new issues requiring a new search. In response, Appellants filed a Continued Prosecution Application (CPA) on January 29, 2002, that requested consideration of the amendments submitted December 21, 2001.

In an Office Action dated March 19, 2002, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Astle (U.S. Patent No. 5,751,861; hereinafter, "Astle") and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated June 6, 2002, claims 1, 19, 23, 34 & 37 were amended.

In a final Office Action dated August 23, 2002, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Astle and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated October 22, 2002, claims 1, 19, 23, 34 & 37 were amended.

In an Advisory Action faxed on November 21, 2002 (and mailed November 26, 2002), Appellants' response was considered, however Appellants' amendments were not entered on grounds that the amendments raised new issues requiring a new search. In response, Appellants filed a Continued Prosecution Application (CPA) on November 22, 2002, that requested consideration of the amendments submitted October 22, 2002.

In an Office Action dated January 17, 2003, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Astle in view of Pearlstein (U.S. Patent No. 5,568,200; hereinafter, "Pearlstein") and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated April 15, 2003, no claims were amended.

In a final Office Action dated July 1, 2003, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Astle in view of Pearlstein and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In response, Appellants filed a Request for Continued Examination (RCE) and accompanying Amendment on September 2, 2003, amending claims 1, 19, 23, 34 & 37.

In an Office Action dated November 24, 2003, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Astle in view of Pearlstein and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim. In Appellants' response dated February 12, 2004, no claims were amended.

In a final Office Action dated May 6, 2004, claims 1, 2, 7, 8, 10-28 and 31-41 were rejected under 35 U.S.C. §103(a) as unpatentable over Reininger in view of Astle in

view of Pearlstein and claims 3-6, 9, 29 and 30 were objected to as being dependent upon a rejected claim.

A Notice of Appeal to the Board of Patent Appeals and Interferences was mailed on June 21, 2004. The status of the pending claims is therefore as follows:

Claims allowed – none;

Claims objected to – 3-6, 9, 29 & 30;

Claims rejected – 1, 2, 7, 8, 10-28 & 31-41; and

Claims canceled – none.

Appellants are appealing the rejection of claims 1, 2, 7, 8, 10-28 & 31-41.

Status of Amendments

Appellants proffered no amendments responsive to the final Office Action dated May 6, 2004. The claims as set out in the Appendix include all prior entered claim amendments.

Summary of the Invention

Appellants' invention is directed to an encoding technique, which minimizes or eliminates perceptible picture pulsation in a sequence of still image frames or partial still frames. (e.g., claims 1, 19, 23, 34 & 37). The encoding technique of the invention can ensure constant picture quality for a series of still pictures and partially still pictures. (Specification, page 15, line 31– page 16, line 4). Further, bits used in encoding a still picture or partially still picture are conserved by encouraging the use of skip macroblocks during the encode process. (Specification, page 22, lines 15-26). Adaptive encoding in accordance with this invention is performed by a pre-encode statistics gathering process and includes programmable still picture detection features. (Specification, page 32, lines 30-33).

As one example, Appellants recite a method for encoding a sequence of video frames (e.g., claim 1, and FIG. 5). The method includes for each frame of a sequence of frames: encoding the frame employing at least one controllable parameter; and adapting

the encoding of the frame when the frame is a still frame (see, specification page 17, line 10 – page 21, line 27) being non-intra encoded by the encoding, the still frame being determined prior to the encoding (see, pre-encode stage 310 of FIG. 5) and comprising a frame with certain content identical and unvarying to certain content of a preceding frame, wherein when the frame is being non-intra encoded (i.e., P or B encoded), the adapting includes adjusting the at least one controllable parameter employed in encoding the still frame to disable motion estimation and limit motion compensation (see, specification page 22, lines 7-26) to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames within the sequence of video frames, wherein the still frame comprises one still frame of the sequence of still frames (specification page 32, lines 19-33).

In a further embodiment (e.g., claim 19, FIG. 9 and specification page 29, line 19 – page 32, line 18), Appellants recite a method for encoding a frame of a sequence of video frames, wherein the frame has a plurality of macroblocks, and the method comprises for each of at least some macroblocks of the plurality of macroblocks: encoding the macroblock employing at least one controllable parameter; and adapting the encoding of the macroblock when the macroblock is a still macroblock being non-intra encoded by the encoding, the still macroblock being determined prior to the encoding and comprising a macroblock with certain content identical and unvarying to certain content of a corresponding macroblock in a preceding frame, wherein when the macroblock is being non-intra encoded, the adapting includes adjusting the at least one controllable parameter employed in encoding the still macroblock to disable motion estimation and limit motion compensation to minimize after decoding thereof, visually perceptible pulsation artifacts between corresponding still macroblocks of adjacent frames in the sequence of video frames.

In further embodiments, the invention comprises determining whether the frame comprises a still frame (e.g., claim 2; specification page 17, line 10 – page 21, line 27) or the macroblock comprises a still macroblock (e.g., claim 20; specification page 29, line 19 – page 32, line 18). In another aspect, each frame comprises a plurality of macroblocks and the method further includes setting a zero motion vector mode ON upon determining that the frame comprises a still frame, and determining a predictive error for EN998027

each macroblock of the still frame, and when the predictive error is less than a predetermined value, setting the predictive error to zero making the macroblock a skip macroblock (e.g., see claims 10, 26 & 39; specification page 22, lines 5-30). In a further aspect, the adapting includes defining a plurality of macroblocks in the still frame as skip macroblocks, and maintaining a minimum quantization level for encoding of each skip macroblock of the still frame (e.g., claims 12 & 27; specification page 22, line 27 – page 23, line 9). Further, the adapting includes maintaining the minimum quantization level for each skip macroblock of the still frame to be an average quantization level of a reference still frame ($AvQL_{ref}$) for the sequence of still frames (e.g., claims 13, 28 & 40; specification page 27, lines 1-4 and page 28, lines 13-27).

Issue

1. Whether claims 1, 2, 7, 8, 10-28 & 31-41 were rendered obvious under 35 U.S.C. §103(a) to one of ordinary skill in the art by Reininger in view of Astle in view of Pearlstein.

Grouping of Claims

Since each ground of rejection provides a grouping of claims, the following group of claims is included herein:

I. Claims 1, 2, 7, 8, 10-28 & 31-41

Appellants respectfully submit that the claims of Group I do not stand or fall together. For example, claims 2, 8, 10, 12, 13, 20, 25-28, 35 & 38-40 each include additional features that provide separate basis of patentability.

Argument

Group I: Claims 1, 2, 7, 8, 10-28 & 31-41

As noted, claims 1, 2, 7, 8, 10-28 & 31-41 stand rejected under 35 U.S.C. §103(a) as obvious over Reininger in view of Astle in view of Pearlstein. Reversal of this rejection is respectfully requested.

Appellants discuss the problem addressed by the present invention in their Background of the Invention. When input video is constant, i.e., comprises a sequence of “still image” frames (i.e., a sequence of frames having content identical and unvarying to content of a preceding frame), slight variations in the amount of detail in a macroblock of a current frame compared to the same macroblock of a prior frame or a next frame in the series of still image frames can create fluctuation in encoded luminance and/or chrominance data, which can appear as movement between frames when decoded, notwithstanding that the initial frames actually comprise a series of still image frames (i.e., identical content frames). For instance, variation in chrominance data from a prior frame to a current frame can create differences in shade of the same color of the encoded and decoded frame. These differences in color shade effectively create “pulsation artifacts” which can cause a series of still image pictures to come alive and no longer resemble the original input video. (See page 3, lines 12-26 of specification).

Two considerations are important to preventing pulsation between still image pictures. One consideration is that the same coding type be employed from still image picture to still image picture, and the second is that a comparable level of quantization be maintained for the same macroblock from still picture to still picture. However, these coding options can only be applied when a picture is first determined to be a still picture (i.e., still frame). (See page 15, line 3 – page 16, line 26 of Appellants’ specification).

Appellants recite in the independent claims that the “still frame” and “still macroblock” comprise a frame (or macroblock) with content identical and unvarying to content of a preceding frame (or a corresponding macroblock in a preceding frame). Thus, the phrase “sequence of still frames” as defined in the application and used in the

claims, is distinguishable from the interpretation given the phrase in the final Office Action. Appellants recognize as suggested by the Examiner that each frame in a sequence of frames is just that, a frame itself. However, the phrase “still frame” or “still macroblock” is used in the present application to mean that certain content of the frame does not vary from one frame to the next, i.e., that the content is fixed over a period of time such that a particular frame has little or no pixel difference with the frame preceding it. For example, a motionless test pattern depicted over a period of time so as to be represented by multiple frames would mean that there is a sequence of still frames such that any one frame contains content that is identical and unvarying to content of a preceding frame.

By way of further explanation, one specific definition of a “still frame” is an input frame to an encoder whose pixel data does not vary by either value or position with respect to the temporally previous frame input to the encoder. That is, frame $i+1$ contains identical pixel data to frame i for the entire frame. An example of such a still frame would be that the exact same picture is being fed into an encoder over a period of time.

As a further example, a partially still frame may comprise an object or objects within an input frame to an encoder whose pixel data does not vary by either value or position with respect to the same object or objects contained within a temporally previous frame input to the encoder. That is, frame $i+1$ contains identical pixel data for an object or objects contained within the frame to the identical object or objects contained within frame i . An example of a partially still frame would be a series of frames whose background is constant, say a tree or house, which does not move or change position, although an object or objects in the foreground may, such as a car driving by the house.

The meaning of Appellants’ claimed “still frame” is significant to the present invention. The problem addressed by the present invention is the existence of “pulsation artifacts” which may occur after decoding of a series of encoded still frames. As used in the present application, “pulsation artifacts” can be the result of encoding and decoding processes on successive frames having certain identical and unvarying content (i.e., still frames). Due to slight variations in the details in the encoded frames, visually apparent fluctuations in the decoded and displayed images may occur. These differences may give

the impression of motion, and are known in the art as pulsation artifacts. Thus, while the initially received sequence of video frames may comprise a series of identical “still frames” in raw data format, after the still frames have undergone lossy compression and decompression (i.e., encoding and decoding) there may visually appear artifacts in the ultimately displayed image resulting from the lossy compression and decompression of the images. The present invention eliminates these artifacts with display of the ultimate image.

In accordance with Appellants’ invention, a determination is first made that a still frame in a sequence of still frames in a series of video frames has been received at the encoder. The independent claims expressly recite that a “still frame” comprises a frame with certain content identical and unvarying to certain content of a preceding frame. Thus, a sequence of still frames comprises a special case within a sequence of frames wherein there is no motion of certain content from one frame to the next. Appellants then adapt encoding of that still frame in order to minimize subsequently occurring visually perceptible pulsation artifacts between that still frame and an adjacent still frame after the frames have undergone encoding and decoding.

In comparison, Reininger describes a multi-pass encode system which uses the number of bits produced from encoding a macroblock as feedback to change the quantizer used on the same macroblock in the same frame in a next encode pass. If the number of bits produced for a macroblock on a pass is greater than a threshold number, then the quantizer is changed for a next encode pass.

Initially, Appellants note that Reininger does not address or discuss the same problem as that addressed by the their invention. A careful reading of Reininger fails to uncover any discussion of processing still frames as the term is defined and used in the present application, let alone of recognizing the pulsation artifact problem addressed by Appellants. Reininger addresses the uniformity of image quality by limiting the amount of compressed data produced by the encoding process. Appellants’ invention, however, is directed to minimizing visually perceptible pulsation artifacts occurring in a sequence of still frames which are displayed after undergoing encoding and decoding of the identical frames.

In contrast, Reininger discloses a system for encoding video data which includes calculating the bits produced and encoded (i.e., compressed) for macroblocks within a single frame, and using this information as feedback for further refinements in the encode process.

Reininger determines the number of bits produced for macroblocks within a frame, and if the size is too large, then the quantizer is changed for the subsequent encode pass. Essentially, Reininger discloses a constant bit rate encode process which seeks to maintain picture quality without violating the constant bit rate. To accomplish this, Reininger evaluates the same picture in compressed data format multiple times (see column 4, lines 3 et al.). Appellants respectfully submit that this process of Reininger is substantially different from Appellants' recited processes.

The final Office Action essentially mischaracterizes a still frame as an I-picture. This mischaracterization of the prior art and application thereof to the problem addressed by the present invention is respectfully traversed. Each of the independent claims presented herewith defines "still frame" (or "still macroblock") as a frame (or macroblock) that has content identical and unvarying to certain content in the preceding frame or macroblock in a series of frames. Thus, the still frame or macroblock has minimal pixel difference from one input frame to the next. It is the existence of such still frames which gives rise to the problem addressed by the present invention. Not every frame in a group of frames to be encoded necessarily comprises a still frame. Typically, there is content motion (i.e., change) from one video frame to the next in a sequence of video frames. If there is content motion from one frame to a subsequent frame, then the frames do not comprise still frames as defined in the present application.

In contrast to Appellants' "still frame" to be encoded, an "I-picture" refers to a type of encoding performed by an encoding process on a frame. As is well known in the art, a frame can be encoded as an I, P or B frame. Thus, an I-picture or reference picture refers to a type of picture resulting from the encoding process. In the present application, the "still frame" comprises a frame characterization which is determined prior to the encoding process. As noted above, Appellants' "still frame" refers to there being certain content identical and unvarying to certain content in the preceding frame. Once a still

frame is identified, then in Appellants' process the encoding is adapted to minimize after decoding of the encoded stream, visually perceptible pulsation artifacts between still frames of a sequence of still frames. Appellants' use of "still frame" has nothing to do with the type of picture encoding employed for the frame. A still frame could be encoded as an I, P or B picture.

To summarize, Appellants are addressing a problem unique from that of Reininger. Appellants seek to minimize visually perceptible pulsation artifacts which occur in a displayed video stream after the stream has undergone encoding and decoding processes, and in particular, which occur where the stream to be encoded and decoded contains a series of still frames, i.e., frames with at least partial content which is identical and unvarying from frame to frame. Reininger does not address or even discuss the existence of a series of still frames within a sequence of video frames, nor does the patent address the problem of visually perceptible pulsation artifacts occurring upon displaying a sequence of still frames which have undergone encode and decode processes. Appellants' invention comprises a technique for minimizing pulsation artifacts by adjusting the encode process of the frame after the frame is identified to comprise a still frame. Appellants respectfully submit that a careful reading of Reininger fails to uncover any teaching or suggestion of such a technique.

Appellants' independent claims further specify that the adapting of the encoding of the frame occurs when the frame is a still frame which is being non-intra encoded. When the frame is being non-intra encoded, the adapting includes adjusting the at least one controllable parameter employed in encoding the still frame to disable motion estimation and limit motion compensation. This disabling of the motion estimation and limiting of motion compensation for the non-intra encoded frame is performed to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames. Disabling motion estimation and limiting motion compensation encourages the skipping of macroblocks in the still frame being non-intra encoded. By definition, a skipped macroblock is duplicated, without change, from a prior, reference picture.

None of the applied art, individually or in combination, teaches or suggests adapting non-intra encoding of a still frame to adjust at least one controllable parameter employed in encoding the still frame to disable motion estimation and limit motion compensation. In non-intra coding, both motion estimation and motion compensation are conventionally employed.

In the present application, after determining that a frame is contained within a sequence of still frames, motion estimation is disabled to ensure that the motion estimation vector is zero, thereby allowing a reference frame versus current frame comparison to be performed on the same coordinates or placement within the frames. For example, if a current macroblock of a frame is located within a still frame at pixel row index 48 and pixel column index 64, the only comparison allowed will be at the same coordinates in the reference frame.

Further, motion compensation is limited in a still frame by allowing any difference value between the two macroblocks that fall below a predetermined threshold to be nullified or artificially set to zero. This allows macroblocks that would ordinarily fail the criteria for skipping to be skipped, thus reducing or eliminating the possible artifacts that would occur in normal compensated macroblocks due to lossy compression noise.

Neither Reininger, Astle, nor Pearlstein taken separately or together, teach or suggest Appellants' above-noted process for artifact reduction when non-intra encoding frames with constant content from frame to frame (i.e., still frames contained within a still sequence of frames). Neither Reininger, Astle, nor Pearlstein address the disabling of motion estimation to guarantee zero valued motion vectors, nor do any of these patents discuss a threshold for artificially nullifying macroblock differences and thus limiting motion compensation for the purpose of allowing more skipped macroblocks within a still frame during the non-intra encoding process.

The final Office Action acknowledges that Reininger does not disclose Appellants' limitation of "minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames". The teachings of Astle and cited to address the deficiencies of Reininger in this regard.

Astle teaches low-pass filtering to eliminate block-edge artifacts, thus changing the values of some of the pixels themselves within the current picture. A careful reading of Astle fails to uncover any teaching or suggestion of an adaptive encoding approach wherein motion estimation is disabled and motion compensation is limited when non-intra encoding a still frame of a sequence of still frames, let alone such adapting to minimize, after decoding thereof, visually perceptible pulsation artifacts between still frames of the sequence as recited by Appellants in their independent claims.

The final Office Action alleges that the “block edge artifacts” discussed in Astle equate to the “pulsation artifacts” defined by Appellants in the independent claims presented herewith. The Examiner’s use of “pulsation artifact” as a substitution for “block edge artifacts” in the Astle discussion is respectfully traversed.

As understood by one skilled in the art, the phrase “block edge artifacts”, in the discussion of Astle, describe artifacts caused within a picture itself from difficulty in encoding pixels of different frequencies, for example, when transitioning from a black edge to a white space. In contrast to this artifact, Appellants’ “pulsation artifacts” are temporal artifacts caused by difference in compression ratios between two sequential pictures.

The phrase “pulsation artifacts” is understood in the art and defined in the present application to mean visually perceptible pulsations which may occur in a sequence of still content frames which have been displayed after undergoing encoding and decoding of the identical frames.

Additionally, a careful reading of Astle fails to uncover any teaching or suggestion of a process for adapting encoding of a frame when the frame is a “still frame” as defined in Appellants’ independent claims. Thus, Appellants respectfully traverse the characterization in the Office Action that “... Astle discloses the illumination of the block edge artifacts (i.e., pulsation artifacts) after the decoding of a series of encoded still frames or images (Col. 6, lines 25-47).” There is no discussion or suggestion in Astle that the individual frames that are being decoded are still frames having still content similar to the present application. The Office Action’s characterization of the teachings of Astle as relating to decoding of a series of encoded still frames is without basis in the Astle patent, EN998027

and therefore believed erroneous. There is no discussion in Astle of a still frame, nor is there discussion in Astle of a series of still frames to be encoded. Further, Astle is not even discussing an encoding process, but rather is addressing the decoding process. The Astle patent relates to a problem which is different from that of the present invention. In Astle, the problem of “block edge artifacts” is addressed by smoothing out a picture using blending techniques during the decoding process. For all the above reasons, the problem addressed by Astle, and the teachings thereof, are clearly different from Appellants’ recited invention.

The final Office Action acknowledges that Reininger and Astle do not disclose Appellants’ characterization of the encoding process as “disabling motion estimation and limiting motion compensation”. The Office Action cites the teachings of Pearlstein to allegedly address this deficiency of Reininger and Astle as applied against their independent claims. For example, the final Office Action alleges that Pearlstein teaches:

“... the disablement of motion compensation and limiting motion compensation (in col. 8, lines 41-58), Pearlstein discloses that the use of a refresh control processor which utilizes a refresh descriptor data for inhibiting frame display until an appropriate amount of non-erroneous image data develops for decoding; further, in col. 9, lines 6-19, Pearlstein discloses that until an appropriate amount of non-erroneous image data is constructed, the image data is refreshed meaning that previous image data is repetitiously sent until the complete reference frame is constructed, thus, stopping motion estimation and limiting motion compensation until non-erroneous image data is constructed so as to display clear, high quality image data”.

The above characterizations of the teachings of Pearlstein and their alleged applicability to Appellants’ claims are respectfully traversed for multiple reasons. Pearlstein is principally directed to decoding processes, not encoding processes, as claimed by Appellants. Further, there is no motion estimation or motion compensation process discussion in the Pearlstein process, since again, Pearlstein is principally discussing decoding, not encoding. In addition, the image data discussed at columns 8 & 9 of Pearlstein comprises the decoded pixel data. Again, one skilled in the art would understand that decoded pixel data would not have any motion estimation or motion compensation characteristics. Still further, disabling the frame display does not equate to limiting motion estimation or motion compensation during the encoding process.

Disabling frame display in Pearlstein is intended to allow sufficient time to buffer pictures to be displayed after the decoding process. Demodulator 26 is employed after the decode process. Pearlstein is directed to saving portions of a picture in order that there be sufficient data to display. Further, Pearlstein discusses intra-coded portions of pictures. One skilled in the art would understand that an intra-coded picture has no motion estimation or motion compensation component to begin with. Intra-coded portions of pictures are encoded strictly with spatial redundancy only, not temporal redundancy. This is contrary to Appellants' independent claims, which expressly recite disabling motion estimation and limiting motion compensation when the still frame is being non-intra encoded.

In view of the differences noted above, Appellants respectfully submit that their invention as recited in independent claims 1, 19, 23, 34 & 37 would not have been obvious to one of ordinary skill in the art based upon the teachings of Reininger, Astle and Pearlstein. Therefore, reversal of the obviousness rejection to these claims is requested.

The dependent claims are believed patentable for the same reasons as the independent claims from which they directly or ultimately depend, as well as for their own additional characterizations. For example, claims 2, 10, 12 & 13 (as well as the corresponding system and computer program product claims) are believed to recite separate basis for patentability.

Claim 2 repeats the subject matter of claim 1, and further adds the characterization that a determination is made whether the frame comprises a still frame. As defined in claim 1, a still frame comprises a frame with certain content identical and unvarying to certain content of a preceding frame. A careful reading of Reininger, Astle and Pearlstein fails to uncover any discussion of determining whether a given frame to be encoded comprises a still frame based on content. Reininger does not address or discuss the existence of a series of still frames within a sequence of video frames to be encoded, and thus does not teach determining whether a frame comprises a still frame as the phrase is defined in the claims. The citations of Astle and Pearlstein do not cure this deficiency of Reininger.

Claim 10 further recites that each frame comprises a plurality of macroblocks and that the method includes setting a zero motion vector mode ON upon determining that a frame still comprises a still frame, and determining a predictive error for each macroblock of the still frame, and when the predictive error is less than a predetermined value, then setting the predictive error to zero, making the macroblock a skip macroblock. In Appellants' recited functionality, there is thus a bias towards identifying a macroblock as a skip macroblock provided that the predictive error is less than a predetermined value. No similar functionality is described by Reininger, Astle or Pearlstein.

Claims 12 & 13 further recite that the adapting includes defining a plurality of macroblocks in the still frame as skip macroblocks and maintaining a minimum quantization level for each skip macroblock of the still frame. This minimum quantization level is recited to be an average quantization level for a reference still frame for the sequence of still frames being encoded. Reininger does not appear to discuss maintaining a minimum quantization level *per se* for each skip macroblock of an identified still frame. Astle and Pearlstein do not cure this deficiency of Reininger.

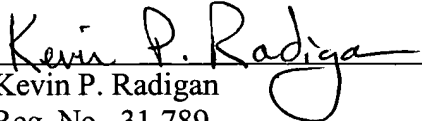
For the above reasons, Appellants respectfully request reversal of the obviousness rejection to all claims of Group I.

Conclusion

Appellants respectfully request reversal of the rejection set forth in the final Office Action. Appellants submit that Reininger in combination with Astle and Pearlstein would not have rendered their claimed invention obvious. These patents do not, individually or in combination, teach or suggest Appellants' recited technique for encoding a sequence of video frames wherein for each frame the technique includes adapting the encoding of the frame when the frame is a still frame being non-intra encoded by the encoding, and wherein the still frame is identified as such prior to the encoding and is a frame with certain content identical and unvarying to certain content of a preceding frame. When the frame is being non-intra encoded, the adapting includes adjusting the at least one controllable parameter employed in encoding the still frame to disable motion estimation and limit motion compensation to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of the sequence of still frames.

For all the above reasons, Appellants allege error in rejecting their claims as obvious based upon Reininger, Astle and Pearlstein. Accordingly, reversal of the rejection is respectfully requested.

Respectfully submitted,


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Appendix

1. A method for encoding a sequence of video frames comprising for each frame of the sequence of video frames:

(a) encoding said frame employing at least one controllable parameter;
and

(b) adapting said encoding (a) of said frame when said frame is a still frame being non-intra encoded by said encoding (a), said still frame being determined prior to said encoding (a) and comprising a frame with certain content identical and unvarying to certain content of a preceding frame, wherein when said frame is being non-intra encoded said adapting including adjusting said at least one controllable parameter employed in encoding said still frame to disable motion estimation and limit motion compensation to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames within said sequence of video frames, wherein said still frame comprises one still frame of said sequence of still frames.

2. The method of claim 1, further comprising determining whether said frame comprises said still frame.

3. The method of claim 2, wherein each frame of the sequence of video frames comprises a plurality of pixels, and wherein each pixel of each frame comprises a multi-bit value and said determining comprises:

determining for a current frame ($k+1$) of the sequence of frames a summation statistic (PIX-SUM_{k+1}) derived from said multi-bit values of the plurality of pixels of the current frame;

determining a summation statistic (PIX-SUM_k) derived from the multi-bit values of the plurality of pixels of a prior frame (k) preceding the current frame ($k+1$) in the sequence of video frames; and

determining whether:

$$| \text{PIX-SUM}_k - \text{PIX-SUM}_{k+1} | < X$$

where X is a predefined value representative of a still frame.

4. The method of claim 3, wherein said determining further comprises:

determining an accumulated absolute difference derived from adjacent pixels of said plurality of pixels of the current frame (PIX-DIFF_{k+1});

determining an accumulated absolute difference derived from adjacent pixels of said prior frame (PIX-DIFF_k); and

determining whether:

$$| \text{PIX-DIFF}_k - \text{PIX-DIFF}_{k+1} | < Y$$

wherein Y is a predefined value, and wherein said current frame is determined to comprise said still frame if both $| \text{PIX-SUM}_k - \text{PIX-SUM}_{k+1} | < X$ and $| \text{PIX-DIFF}_k - \text{PIX-DIFF}_{k+1} | < Y$ are true.

5. The method of claim 4, wherein said determining further comprises dividing the current frame and the prior frame into z corresponding regions, and wherein said determining comprises determining whether for each of said z corresponding regions:

$$| \text{PIX-SUM}_{kz} - \text{PIX-SUM}_{(k+1)z} | < X.$$

6. The method of claim 5, wherein $X = 256$, $Y = 256$, and $z \geq 4$, and wherein said four corresponding regions of said current frame and said prior frame comprise four horizontal bands.

7. The method of claim 2, further comprising determining whether said frame comprises a reference (I) still frame for said sequence of still frames and if so increasing a target bitrate to be used by said encoding (a) to encode said reference still frame.

8. The method of claim 7, wherein said increasing of the target bitrate for said reference still frame comprises detecting a subsequent B or P still frame in said sequence of still frames and moving target bits from said subsequent B or P still frame to said reference still frame.

9. The method of claim 8, wherein said moving of target bits comprises moving fifty percent of target bits for encoding said subsequent B or P still frame to encoding of said reference still frame.

10. The method of claim 2, wherein each frame comprises a plurality of macroblocks, and said method further comprises setting a zero motion vector mode ON upon determining that said frame comprises a still frame, and determining a predictive error for each macroblock of said still frame, and when said predictive error is less than a predetermined value, setting said predictive error to zero making said macroblock a skip macroblock.

11. The method of claim 10, further comprising calculating a quantization level (QL) for said skip macroblock for use in encoding said macroblock, and comparing the calculated quantization level (QL) to an average quantization level of a reference still frame ($Av\ QL_{ref}$) of said sequence of still frames and replacing said calculated quantization level with said average quantization level of said reference still frame when said calculated quantization level is less than said average quantization level of said reference still frame.

12. The method of claim 1, wherein when said frame comprises a still frame, said adapting (b) comprises defining a plurality of macroblocks in said still frame as skip macroblocks, and maintaining a minimum quantization level for encoding (a) of each skip macroblock of said still frame.

13. The method of claim 12, wherein said adapting (b) comprises maintaining said minimum quantization level for each skip macroblock of said still frame to be an average quantization level of a reference still frame ($Av\ QL_{ref}$) for said sequence of still frames.

14. The method of claim 2, wherein said frame comprises a plurality of macroblocks, and wherein said determining comprises determining whether said frame comprises a motion frame, and when so, said method further comprises for each of at least some macroblocks of said motion frame:

- (i) determining whether said macroblock comprises a still macroblock;
- (ii) encoding said macroblock employing at least one controllable parameter; and
- (iii) adapting said encoding of said macroblock when said determining (i) determines said macroblock to be said still macroblock, said adapting including adjusting said at least one controllable parameter employed in encoding said still macroblock to minimize after decoding thereof, visually perceptible pulsation artifacts between corresponding still macroblocks of adjacent frames in said sequence of video frames.

15. The method of claim 14, wherein said adapting of said encoding comprises confirming that said still macroblock is other than an edge macroblock and is a non-intra macroblock, and that said frame comprises a P frame, and when confirmed, said method further comprises: determining that a motion vector for said still macroblock is zero and a macroblock difference (MBD) value is less than a predefined value, and when true, encoding said still macroblock as a skip macroblock and assigning a minimum quantization level to said skip macroblock.

16. The method of claim 15, wherein said assigning of the minimum quantization level comprises assigning an average quantization level for a reference frame for said P frame as quantization level for said skip macroblock.

17. The method of claim 14, wherein said adapting of said encoding comprising confirming that said still macroblock is other than an edge macroblock and is a non-intra macroblock, and that said frame comprises a B frame, and when confirmed, said method further comprises: determining that a motion vector for said still macroblock

is equal to a motion vector of a previous macroblock in the B frame and that a macroblock difference (MBD) value is less than a predefined value, and if so, then encoding said still macroblock as a skip macroblock and assigning a minimum quantization level to said skip macroblock.

18. The method of claim 17, wherein said assigning of the minimum quantization level comprises assigning an average quantization level for a reference frame for said B frame as quantization level for said skip macroblock.

19. A method for encoding a frame of a sequence of video frames, said frame having a plurality of macroblocks, said method comprising for each of at least some macroblocks of said plurality of macroblocks:

(a) encoding said macroblock employing at least one controllable parameter; and

(b) adapting said encoding of said macroblock when said macroblock is a still macroblock being non-intra encoded by said encoding (a), said still macroblock being determined prior to said encoding (a) and comprising a macroblock with certain content identical and unvarying to certain content of a corresponding macroblock in a preceding frame, wherein when said macroblock is being non-intra encoded said adapting including adjusting said at least one controllable parameter employed in encoding said still macroblock to disable motion estimation and limit motion compensation to minimize after decoding thereof, visually perceptible pulsation artifacts between corresponding still macroblocks of adjacent frames in said sequence of video frames.

20. The method of claim 19, further comprising determining whether said macroblock comprises said still macroblock.

21. The method of claim 19, wherein said adapting of said encoding comprises encoding said still macroblock as a skip macroblock and assigning a minimum quantization level to said skip macroblock.

22. The method of claim 20, wherein said assigning of the minimum quantization level comprises assigning an average quantization level of a reference frame to said frame as said minimum quantization level for said still macroblock.

23. A system for encoding a sequence of video frames comprising:

a pre-encode processing unit, said pre-encode processing unit comprising:

a statistics measurement unit for use in determining prior to encoding whether a current frame of the sequence of frames comprises a still frame, said still frame comprising a frame with certain content identical and unvarying to certain content of a preceding frame;

a control unit for modifying at least one controllable parameter employed in non-intra encoding said still frame to disable motion estimation and limit motion compensation when said still frame is being non-intra encoded to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames when said statistics measurement unit determines said current frame to comprise said still frame; and

an encoding engine for non-intra encoding said current frame of the sequence of video frames using the at least one controllable encode parameter set by said pre-encode processing unit.

24. The system of claim 23, wherein said statistics measurement unit comprises means for determining whether said current frame comprises a reference still frame, and if so, said control unit comprises means for increasing a target bitrate used by the encoding engine to encode said reference still frame.

25. The system of claim 24, wherein said means for increasing said target bitrate comprises means for transferring target bits from a subsequent still frame in a sequence of still frames to said reference still frame, said reference still frame also being in said sequence of still frames.

26. The system of claim 23, wherein each frame of said sequence of video frames comprises a plurality of macroblocks, and wherein said control unit of said pre-encode processing unit further comprises means for setting zero motion vector mode ON upon determining that said frame comprises a still frame, and means for determining a predictive error for each macroblock of said still frame, and for each macroblock of said still frame for setting its predictive error to zero making said macroblock a skip macroblock when its determined predictive error is less than a predetermined value representative of a still macroblock.

27. The system of claim 26, wherein said control unit further comprises means for maintaining a minimum quantization level for encoding each skip macroblock of said still frame.

28. The system of claim 27, wherein said means for maintaining comprises means for maintaining said minimum quantization level for each skip macroblock of said still frame at an average quantization level of a reference still frame ($Av\ QL_{ref}$) for said sequence of still frames.

29. The system of claim 23, wherein each frame of the sequence of video frames comprises a plurality of pixels, and wherein each pixel of each frame comprises a multi-bit value, and said statistics measurement unit comprises means for:

determining for a current frame (k+1) of the sequence of frames a summation statistic ($PIX-SUM_{k+1}$) derived from said multi-bit values of the plurality of pixels of the current frame;

determining a summation statistic ($PIX-SUM_k$) derived from the multi-bit values of the plurality of pixels of a prior frame (k) preceding the current frame (k+1) in the sequence of video frames; and

determining whether:

$$| PIX-SUM_k - PIX-SUM_{k+1} | < X$$

where X is a predefined value representative of a still frame.

30. The system of claim 29, wherein said control unit further includes means for:

determining an accumulated absolute difference derived from adjacent pixels of said plurality of pixels of the current frame (PIX-DIFF_{k+1});

determining an accumulated absolute difference derived from adjacent pixels of said prior frame (PIX-DIFF_k); and

determining whether:

$$| \text{PIX-DIFF}_k - \text{PIX-DIFF}_{k+1} | < Y$$

wherein Y is a predefined value, and wherein said current frame is determined to comprise said still frame if both $| \text{PIX-SUM}_k - \text{PIX-SUM}_{k+1} | < X$ and $| \text{PIX-DIFF}_k - \text{PIX-DIFF}_{k+1} | < Y$ are true.

31. The system of claim 23, wherein when said current frame comprises other than said still frame, said control unit further comprises means for adapting encoding each of at least one macroblock of said current frame when said macroblock comprises a still macroblock, said means for adapting including means for adjusting said at least one controllable parameter employed in encoding said still macroblock to minimize after decoding thereof, visually perceptible pulsation artifacts between corresponding still macroblocks of adjacent frames in said sequence of video frames.

32. The system of claim 31, wherein said means for adapting comprises means for confirming that said still macroblock is other than an edge macroblock and is a non-intra macroblock, and that said frame comprises a P frame, and wherein said control unit further includes means for determining that a motion vector for said still macroblock is zero and a macroblock difference (MBD) value is less than a predefined value, and when true, said encoding engine further comprises means for encoding said still macroblock as a skip macroblock having a minimum quantization level defined by a quantization level of a reference frame for said P frame.

33. The system of claim 31, wherein said means for adapting comprises means for confirming that said still macroblock is other than an edge macroblock and is a non-intra macroblock, and that said frame comprises a B frame, and wherein said control unit further comprises means for determining that a motion vector for said still macroblock is equal to a motion vector of a previous macroblock in the B frame and that a macroblock difference (MBD) value is less than a predefined value, and when true, said encoding engine further comprises means for encoding said still macroblock as a skip macroblock having a minimum quantization level to said skip macroblock, defined by a quantization level of a reference frame for said B frame.

34. A system for encoding a macroblock of a plurality of macroblocks of a frame in a sequence of video frames, said system comprising:

an encoding engine for encoding said macroblock of said frame using at least one controllable encode parameter; and

means for adapting said encoding of said macroblock when said macroblock is a still macroblock being non-intra encoded by said encoding engine, said still macroblock being determined prior to receipt of the still macroblock at the encoding engine, and comprising a macroblock with certain content identical and unvarying to certain content of a corresponding macroblock in a preceding frame, wherein when said macroblock is being non-intra encoded said adapting including means for adjusting said at least one controllable parameter employed in encoding said still macroblock to disable motion estimation and limit motion compensation to minimize after decoding thereof, visually perceptible pulsation artifacts between corresponding still macroblocks of adjacent frames in said sequence of video frames.

35. The system of claim 34, further comprising means for determining whether said macroblock comprises said still macroblock.

36. The system of claim 35, wherein said means for adapting of said encoding comprises means for adjusting encoding of said still macroblock to encode said still macroblock as a skip macroblock and to encode said skip macroblock with a minimum

quantization level defined by a quantization level of a reference frame to said frame having said still macroblock.

37. A computer program product comprising a computer usable medium having computer readable program code means therein for use in encoding a sequence of video frames, said computer readable program code means in said computer program product comprising for each frame of the sequence of video frames:

computer readable program code means for causing a computer to affect determining, prior to encoding, whether said frame comprises a still frame, said still frame comprising a frame with certain content identical and unvarying to certain content of a preceding frame;

computer readable program code means for causing a computer to affect non-intra encoding said frame employing at least one controllable encode parameter; and

computer readable program code means for causing a computer to affect adapting said encoding of said frame when said determining determines said frame to be said still frame being non-intra encoded, wherein when said frame is being non-intra encoded said adapting including adjusting said at least one controllable parameter employed in encoding said still frame to disable motion estimation and limit motion compensation to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames within said sequence of video frames, wherein said still frame comprises one still frame of said sequence of still frames.

38. The computer readable program code means of claim 37, wherein said computer readable program code means for causing a computer to affect determining comprises computer readable program code means for causing a computer to affect determining whether said frame comprises a reference (I) still frame for said sequence of still frames, and when so, said computer readable program code means for causing a computer to affect adapting comprises computer readable program code means for causing a computer to affect increasing a target bitrate to be used by said encoding to

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encode said reference still frame by moving target bits from at least one subsequent still frame of said sequence of still frames to said reference still frame.

39. The computer readable program code means of claim 38, wherein each frame of said sequence of video frames comprises a plurality of macroblocks, and wherein said computer readable program code means for causing a computer to affect adapting comprises computer readable program code means for causing a computer to affect setting a zero motion vector mode ON upon determining that said frame comprises said still frame, and for determining a predictive error for each macroblock of said still frame, and when said predictive error is less than a predetermined value, for setting said predictive error to zero making said macroblock a skip macroblock.

40. The computer readable program code means of claim 39, wherein said computer readable program code means for causing a computer to affect adapting comprises computer readable program code means for causing a computer to affect maintaining a minimum quantization level for encoding each skip macroblock of said still frame, wherein said minimum quantization level comprises an average quantization level of a reference still frame for said sequence of still frames.

41. The computer readable program code means of claim 37, wherein said frame comprises a plurality of macroblocks, and wherein said computer readable program code means for causing a computer to affect determining comprises computer readable program code means for causing a computer to affect determining whether said frame comprises a motion frame, and when so, said computer readable program code means further comprises for each of at least some macroblocks of said motion frame:

computer readable program code means for causing a computer to affect determining whether said macroblock comprises a still macroblock;

computer readable program code means for causing a computer to affect encoding said macroblock employing at least one controllable parameter; and

computer readable program code means for causing a computer to affect adapting said encoding of said macroblock when said macroblock comprises said

still macroblock, said adapting including adjusting said at least one controllable parameter employed in encoding said still macroblock to minimize after decoding thereof, visually perceptible pulsation artifacts between corresponding still macroblocks of adjacent frames in said sequence of video frames.
